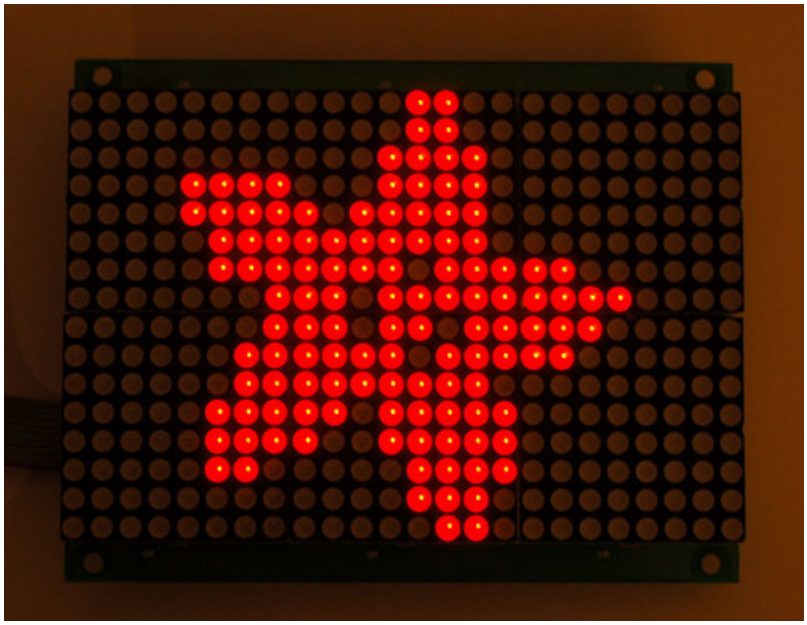
adafruit learning system

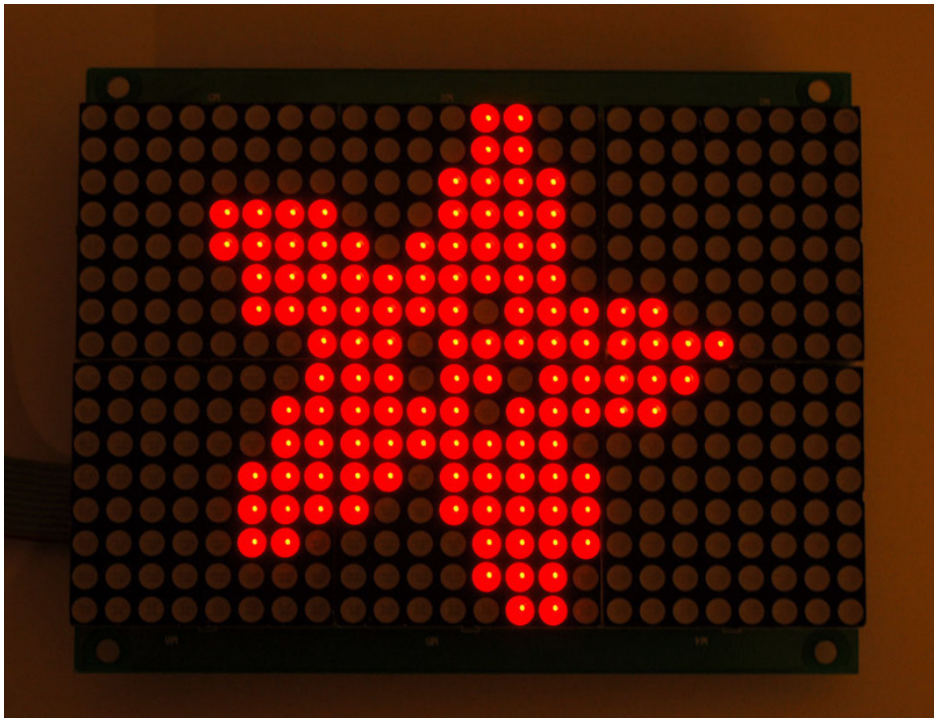
16x24 LED Matrix

Created by lady ada



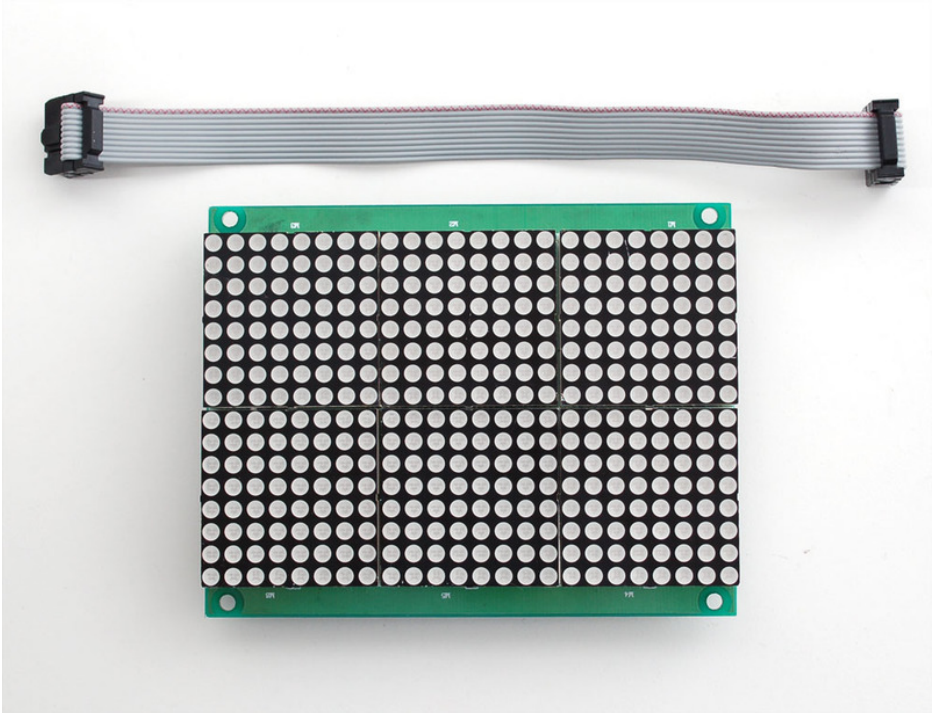
Last updated on 2020-05-18 09:23:10 PM EDT

Introduction



These LED panels take care of all the work of making a big matrix display. Each panel has six 8x8 red matrix modules, for a 16x24 matrix. The panel has a **HT1632C** chip on the back with does all the multiplexing work for you and has a 3-pin SPI-like serial interface to talk to it and set LEDs on or off. There's a few extras as well, such as being able to change the brightness of the entire display, or blink the entire display at 1 Hz.

One really nice thing about this particular LED matrix module is that it is designed to be 'chainable' - you can connect to 8 panels together to make an extra long display.



And of course, we have written a full Arduino library that not only takes care of controlling the display, it also intelligently handles chained displays, so that they appear to be one long matrix. The library has functions for drawing pixels, lines, rectangles, circles and text. You'll be making it display stuff in 15 minutes!

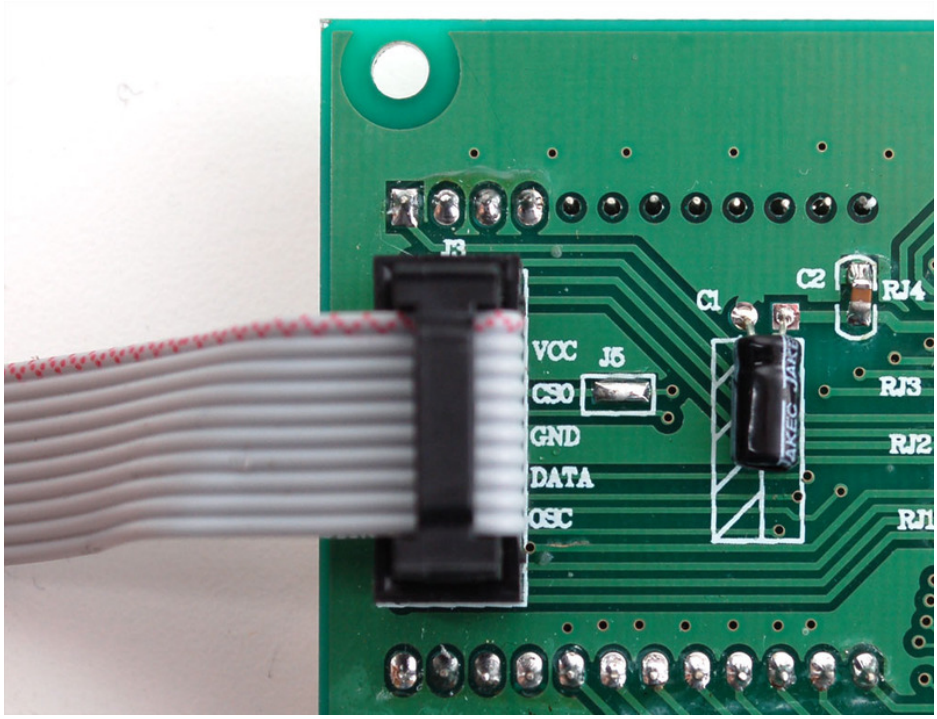
Wiring

Wiring for one panel

Wiring is thankfully fairly simple, much easier than trying to actually wire up 6 x 8x8 matrices. The HT1632C driver chip requires only 3 data pins -**data**, **write**, and **chip select (cs)**. You can't skip using **cs** like many 'true' SPI devices. One of the nice things about these chips is that they are designed to be used in multiples, so you can share the **data** and **write** pins. However, *each HT1632C must have its own **cs** pin!* So if you have one display, you need 3 pins, two displays need 4 pins, three displays need 5, etc.

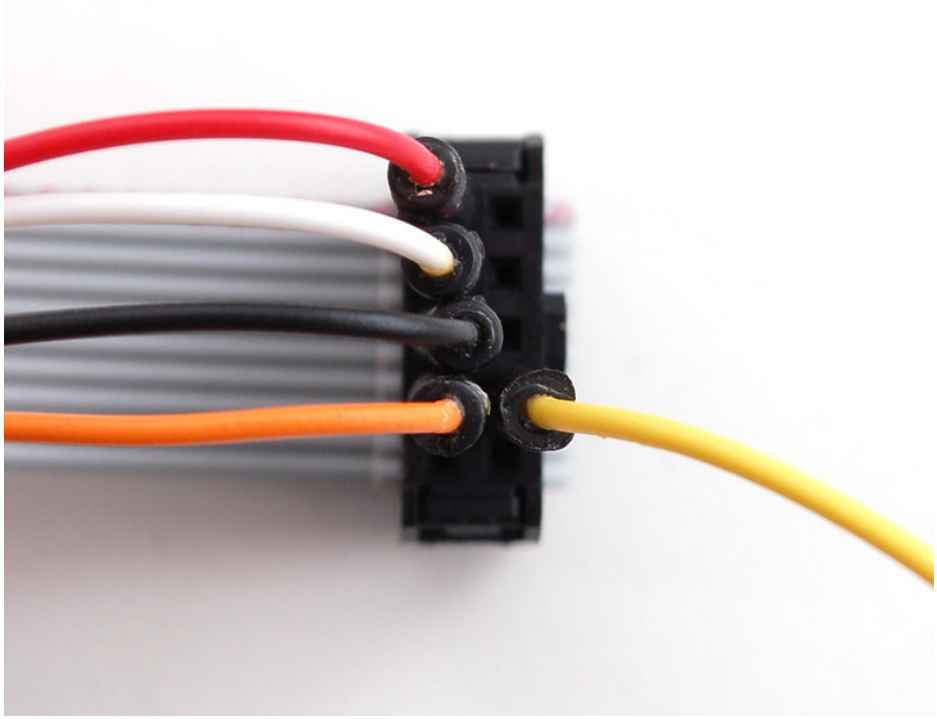
Lets assume you'll be using a single panel to start (and then show how to wire up multiples).

Begin by plugging in a 2x5 pin IDC cable into the top left socket:



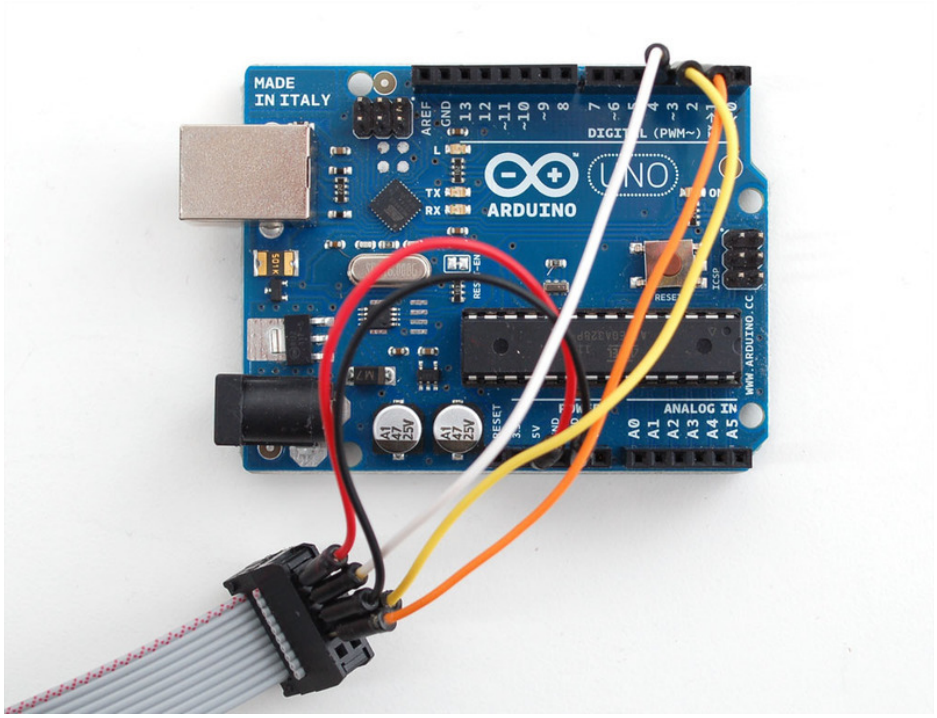
You should also check that the **J5** solder jumper is 'filled' with solder - you need to have **J5** shorted for using one or two panels in a cascade. Use a soldering iron to heat up some solder and melt it on to **J5** if it isn't filled yet.

Next, you will need a few wires, we will use the following convention: a Red wire for **VCC** (+5V), a Black wire for **Ground**, a White wire for **CS0** (chip select #0), an orange wire for **Data** and a yellow wire for **Write**. Make sure that when you look at the other side of the IDC cable to plug in the wires, you have the connector arranged right, the red stripe on the IDC is on the same side as the red wire for **VCC**.



Finally, you can wire the panel up to your Arduino. You can use another microcontroller, if you adapt the code but we will use an Arduino.

Connect **VCC** (red) to +5V, **GROUND** (black) to Ground, **DATA** (orange) to digital **2**, **WRITE** (yellow) to digital **3**, and **CS0** (white) to digital **4**.



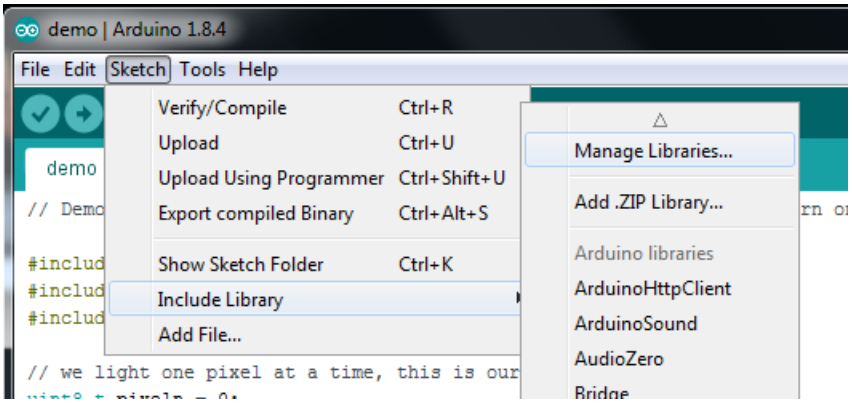
Thats it! Now you are ready to perform the panel test.

Testing

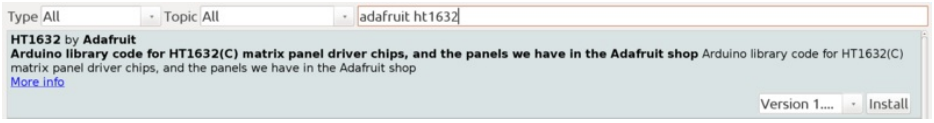
Download Adafruit_HT1632 library

To begin reading sensor data, you will need to download Adafruit_HT1632 and Adafruit_GFX from the Arduino library manager.

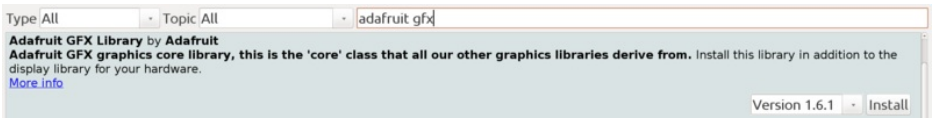
Open up the Arduino library manager:



Search for the **Adafruit HT1632** library and install it



Search for the **Adafruit GFX** library and install it



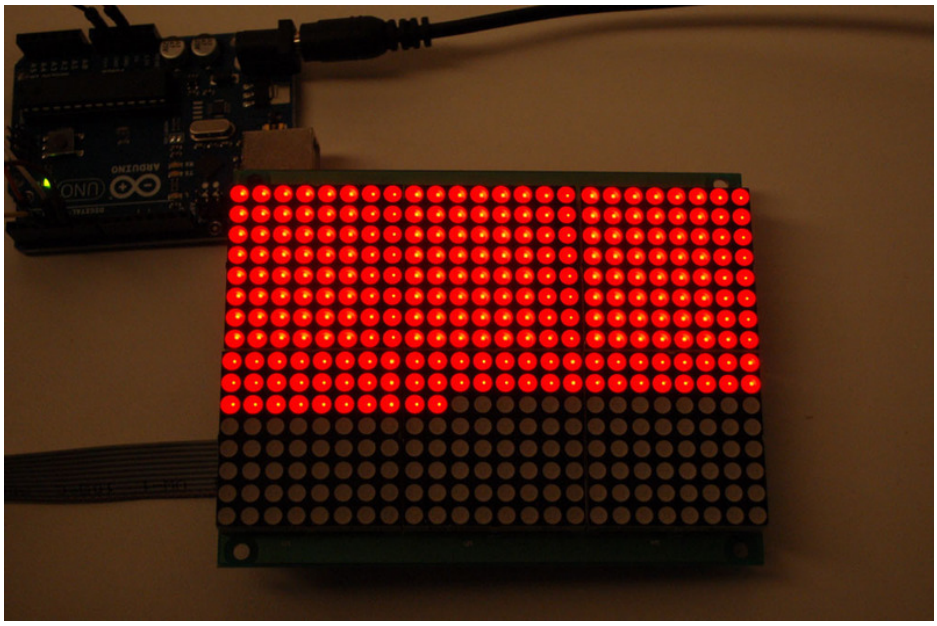
If using an earlier version of the Arduino IDE (prior to 1.8.10), also locate and install **Adafruit_BusIO** (newer versions will install this dependency automatically).

We also have a great tutorial on Arduino library installation at:
http://learn.adafruit.com/adafruit-all-about-arduino-libraries-install-use (https://adafru.it/aYM)

Now you are ready to test! Open up the IDE and load **File→Examples→Adafruit_HT1632→basicdemo** and upload it to your Arduino.

This code will do a basic test of the underlying chip, and light up the LEDs on the panel. The LEDs will not light up in order because the memory of the driver doesn't match the layout of the LEDs (this is normal, we fix the problem later!)

Once you have done the low level test, open up **File→Examples→Adafruit_HT1632→matrixdemo** - this is a more useful demo, it will light up all the LEDs in order on the panel.



Libraries

Low and High Level Library

The library contains two types of objects, one called **Adafruit_HT1632** and one called **Adafruit_HT1632LEDMatrix**. The former is a low level library, that is meant to talk to one controller chip at a time and directly to the locations in memory, and the latter is a full featured library object, that does proper LED location translation, and handles multiple panels.

The last point is an important one. You can "chain" HT1632's together so that they share data/write lines but you still have to figure out how to get text to split nicely across the seperate panels. We've taken care of that hard part for you with the library.

For example, if you want two panels in a row, simply add a second **CS** line at the end of the object creation.

```
// use this line for single matrix
//Adafruit_HT1632LEDMatrix matrix = Adafruit_HT1632LEDMatrix(DATA, WR, CS);
// use this line for two matrices!
Adafruit_HT1632LEDMatrix matrix = Adafruit_HT1632LEDMatrix(DATA, WR, CS, CS2);
```

The **Adafruit_HT1632LEDMatrix** object will automatically think of itself as a 16x48 LED matrix instead of a 16x24 and when you draw text or shapes, they will be split properly.

Right now the library suppors up to 4 panels in a row

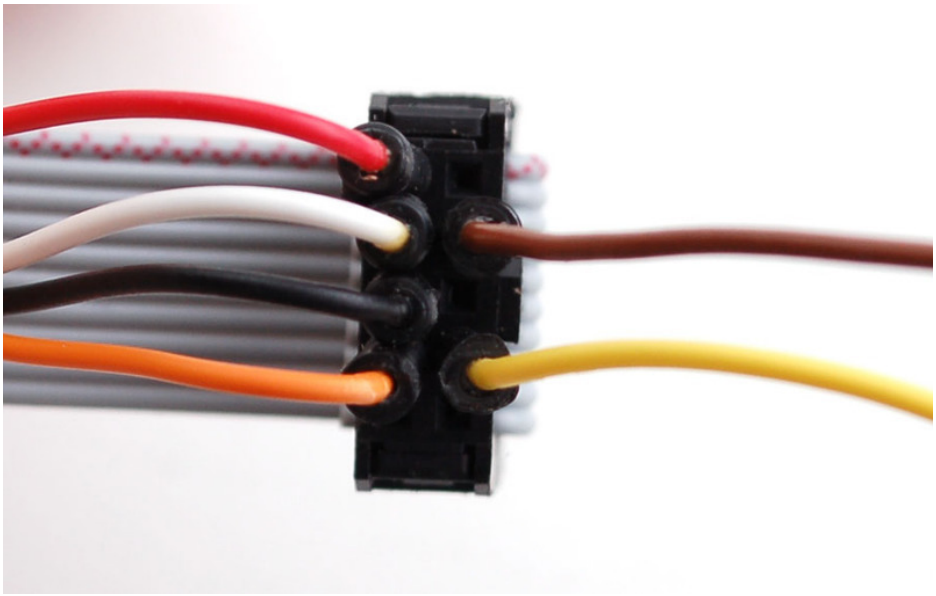
Chances are you will never want to use **Adafruit_HT1632** objects directly, instead using **Adafruit_HT1632LEDMatrix** but we wanted to discuss why there are two.

Multiple Displays

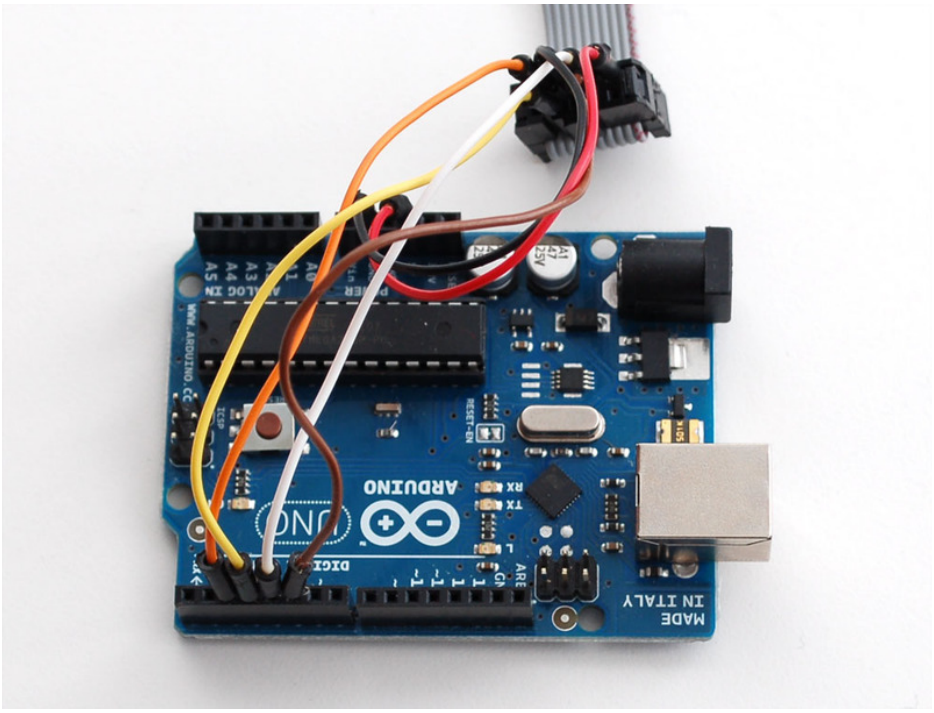
Two displays!

Adding a second display is very easy. First, we do suggest testing both seperately as above. Once you know they work, connect the upper right header of the first panel to the upper left of the second. You can use a long or shorty IDC cable, we happen to like the short ones but the long ones will work fine (they're a little more bulky of course).

Then connect another wire (brown this time) to **CS1** this is the **CS** line for the *second* panel.



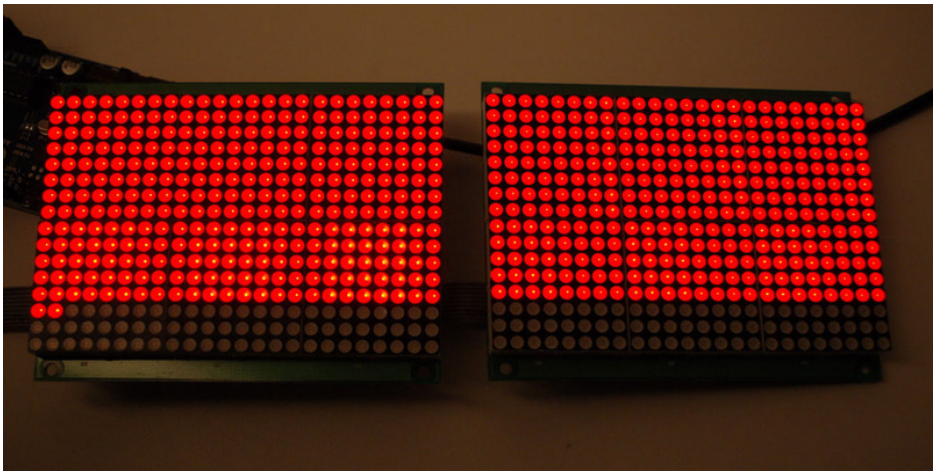
Connect **CS1** to digital **5** on the Arduino.



Open up the **File→Examples→Adafruit_HT1632→matrixdemo** example sketch and change the top part so that you have two panels active, like this:

```
// use this line for single matrix
//Adafruit_HT1632LEDMatrix matrix = Adafruit_HT1632LEDMatrix(DATA, WR, CS);
// use this line for two matrices!
Adafruit_HT1632LEDMatrix matrix = Adafruit_HT1632LEDMatrix(DATA, WR, CS, CS2);
```

Now upload the **matrixdemo** test to see the panels light up in order.

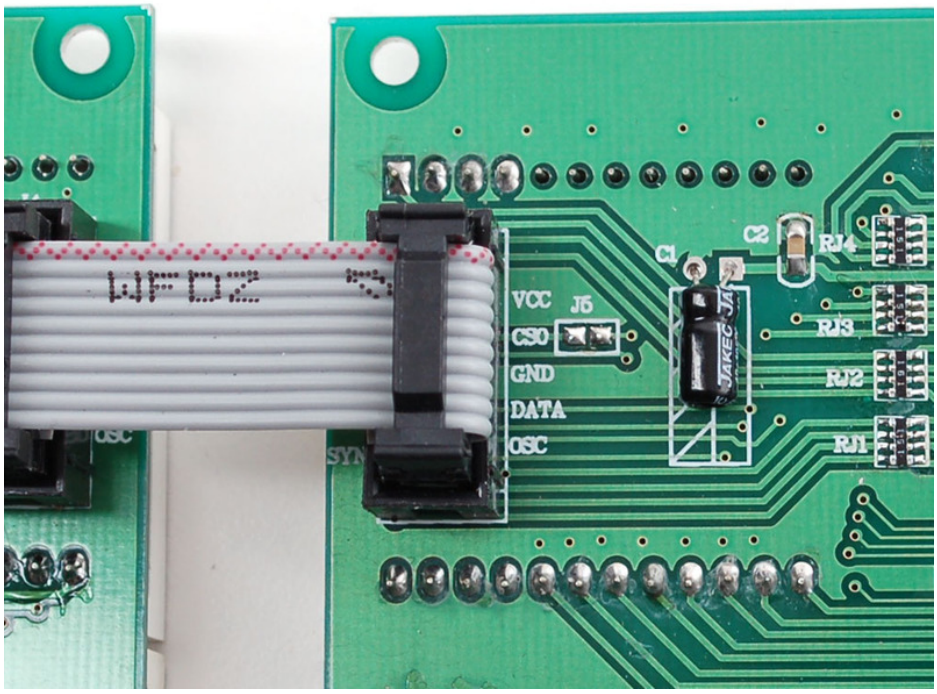


3-10 displays

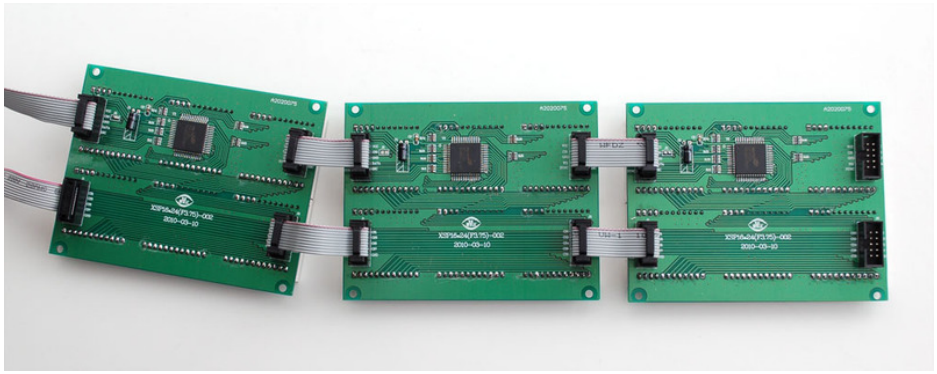
You can chain up to 8 displays, but the system for wiring is a little bit different. Instead of using one cable, you'll need two between each panel. That is so each of the **CSn** pins can be addressed - the second 10-pin cable has 8 **CS** pins.

To perform the chain, first you will need to remove the **J5** jumper using wick and a soldering iron. This will let you use

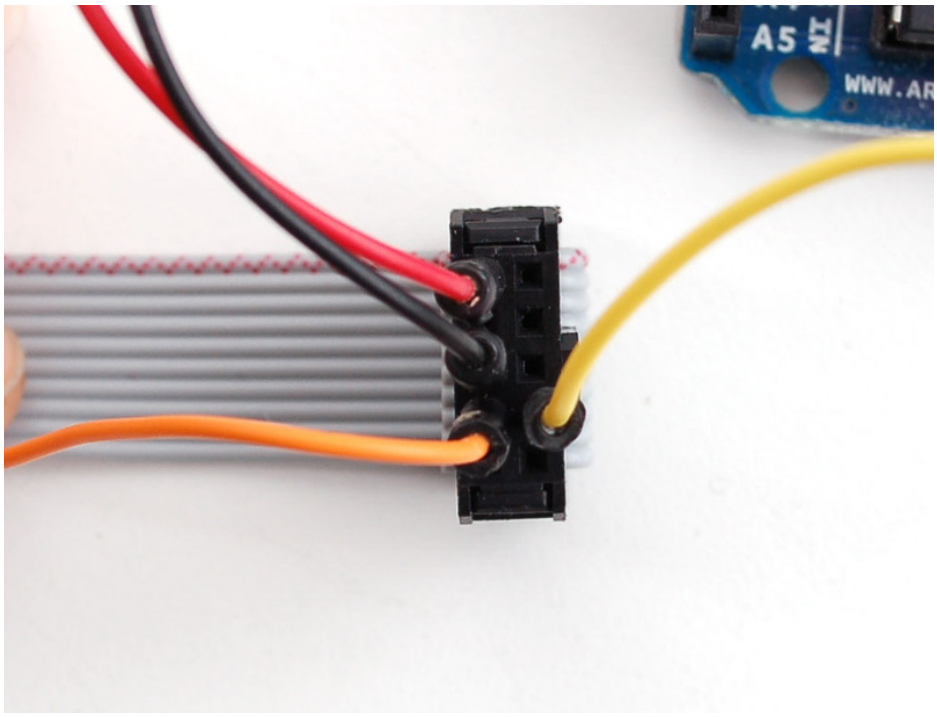
the second IDC **CS** pins.



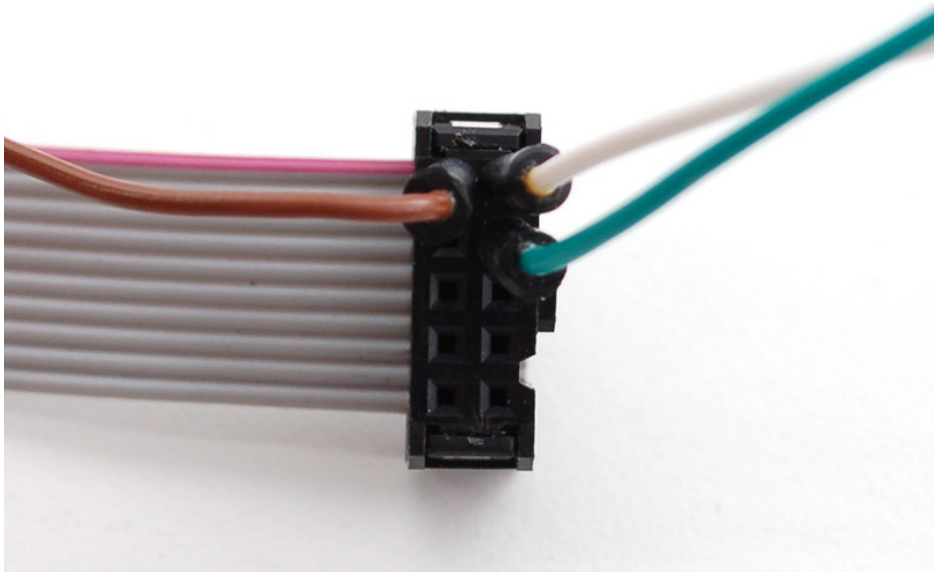
Then chain panels so that two cables go between each set, we suggest shorty cables.



Finally, you will need to use both IDC cables. The first (top left) cable has **VCC** and **GND**, as well as **DATA** and **WRITE** as in the previous tests.



Then on the second IDC (bottom left) you can connect **CS0** (white), **CS1** (brown), and **CS2** (green). We connected **CS2** to digital **6**.



Then of course change the object creation to match that you have three CS pins.

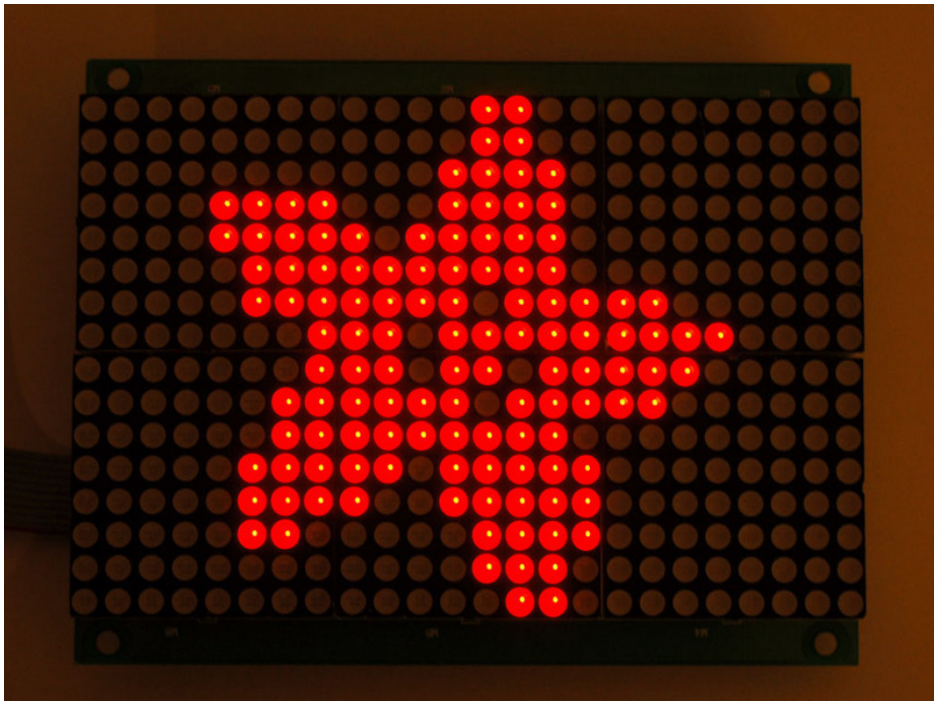
```
// use this line for three matrices!
Adafruit_HT1632LEDMatrix matrix = Adafruit_HT1632LEDMatrix(DATA, WR, CS, CS2, CS3);
```

You can do the same for 4 panels by adding another CS pin.

How many cables do I need?

Depending on how many you want to chain, the number of cables will vary. For 3 or more panels, you will need **extras.** For more than 2 panels, we suggest using the short IDC cables to keep the wiring neat and avoid having too much power lost to the cable length.

1. One 10-pin IDC cable (included)
2. Two 10-pin IDC cables (included)
3. **Six** IDC cables - two long ones are included so you need **four** more short ones
4. **Eight** IDC cables - two long ones are included so you need **six** more short ones
5. **Ten** IDC cables - two long ones are included so you need **eight** more short ones
6. **Twelve** IDC cables - two long ones are included so you need **ten** more short ones
7. **Fourteen** IDC cables - two long ones are included so you need **twelve** more short ones
8. **Sixteen** IDC cables - two long ones are included so you need **fourteen** more short ones



Drawing Text and Shapes

Now that we have the panels wired up as we want, we can ues the more advanced parts of the library for drawing shapes and text. Depending on how many panels you have hooked up, the total 'width' will be different (24 pixels per panel) so call **width()** to get the total pixel width from the matrix object. You can also call **height() -** which will always be 16 in this case.

The Adafruit_GFX library for Arduino provides a common syntax and set of graphics functions for all of our TFT, LCD and OLED displays. This allows Arduino sketches to easily be adapted between display types with minimal fuss...and any new features, performance improvements and bug fixes will immediately apply across our complete offering of color displays.

The GFX library is what lets you draw points, lines, rectangles, round-rects, triangles, text, etc.

Check out our detailed tutorial here http://learn.adafruit.com/adafruit-gfx-graphics-library (https://adafru.it/aPx)

Downloads

- HT1632C datasheet (https://adafru.it/ckM)